

Appl. No. 10/687,017
Amendment and Response dated June 14, 2006
Reply to Final Office Action of April 14, 2006

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Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Canceled)
2. (Previously presented) The catalyst of claim 15 wherein step (b) comprises hydrolysis of the one or more refractory-oxide precursors.
3. (Previously presented) The catalyst of claim 15 wherein step (b) comprises co-hydrolysis of the one or more refractory-oxide precursors and the one or more structural promoter precursors.
4. (Previously presented) The catalyst of claim 15 wherein step (b) comprises precipitation of the one or more refractory-oxide precursors.
5. (Previously presented) The catalyst of claim 15 wherein step (b) comprises co-precipitation of the one or more refractory-oxide precursors and the one or more structural promoter precursors.
6. (Previously presented) The catalyst of claim 15 wherein the precursor mixture comprises a sol and step (b) comprises gelling the sol.
7. (Previously presented) The catalyst of claim 15 wherein the support precursor comprises alumina and the one or more refractory-oxide precursors comprise alumina precursors.
8. (Previously presented) The catalyst of claim 7 wherein the one or more refractory-oxide precursors are inorganic precursors, wherein the inorganic precursors comprise at least one precursor selected from the group consisting of aluminum nitrate, aluminum sulfate, sodium aluminate, and aluminum chloride.

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9. (Previously presented) The catalyst of claim 7 wherein the one or more refractory-oxide precursors comprise at least one aluminum alkoxide.
10. (Previously presented) The catalyst of claim 7 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support is a modified alumina support.
11. (Previously presented) The catalyst of claim 7 wherein the precursor mixture comprises a sol, and wherein step (b) comprises gelling the sol.
12. (Previously presented) The catalyst of claim 11 wherein gelling the sol occurs at a temperature between about 70 °C and about 100 °C.
13. (Canceled)
14. (Previously presented) The catalyst of claim 15 wherein step (b) further comprises steaming the support precursor.
15. (Currently amended) A catalyst comprising a catalytic metal dispersed on a catalyst support, said catalytic metal comprising Co, Ni, Fe, Ru, or combinations thereof, wherein the catalyst support is prepared by a method comprising:
 - (a) combining one or more refractory-oxide precursors with one or more structural promoter precursors to yield a precursor mixture, wherein the refractory oxide is selected from the group consisting of zirconia, magnesia, titania, alumina, silica, and combinations thereof, and wherein the one or more structural promoter precursors comprise at least one element selected from the group consisting of W, Ta, Nb, Th, Ge, U, Sn, Sb, V, Hf, Na, K, B, Mg, Si, Ca, ~~Ti~~, Cr, Mn, Fe, ~~Co~~, Ni, Cu, Zn, Ga, Sr, Zr, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu;
 - (b) forming a support precursor from the precursor mixture; and
 - (c) calcining the support precursor at a temperature between about 450 °C and about 900 °C to obtain a hydrothermally-stable structurally-promoted refractory-oxide catalyst support, wherein the catalyst support comprises the hydrothermally-stable structurally-promoted refractory-oxide catalyst support and contains from about 1 percent to about 20 percent by weight

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of the structural promoter based on the final weight of the catalyst support.

16. (Canceled)
17. (Withdrawn) A hydrothermal reaction process comprising contacting a feed stream with the catalyst of claim ~~16~~ 15.
18. (Withdrawn) The process according to claim 17 wherein the feed stream comprises synthesis gas and the catalytic metal comprises cobalt.
19. (Withdrawn) The process of claim 18 further comprising converting at least a portion of the synthesis gas to hydrocarbons.
20. (Canceled)
21. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein step (a) comprises hydrolysis of the one or more refractory-oxide precursors.
22. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein step (a) and step (b) comprise co-hydrolysis of the one or more refractory-oxide precursors and the one or more structural promoter precursors.
23. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein step (a) comprises precipitation of the one or more refractory-oxide precursors.
24. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein step (a) and step (b) comprise co-precipitation of the one or more refractory-oxide precursors and the one or more structural promoter precursors.
25. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein step (a) further comprises gelling the refractory-oxide material by a sol-gel process.
26. (Previously presented) The Fischer-Tropsch catalyst of claim 25 wherein the sol-gel process is conducted at a temperature between about 70 °C and about 100 °C.

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27. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein step (b) further comprises gelling the refractory-oxide material by a sol-gel process after adding one or more structural promoter precursors to the refractory-oxide material.
28. (Previously presented) The Fischer-Tropsch catalyst of claim 27, wherein the sol-gel process is conducted at a temperature between about 70 °C and about 100 °C.
29. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein the refractory-oxide material comprises alumina and the one or more refractory-oxide precursors comprise an alumina precursor.
30. (Previously presented) The Fischer-Tropsch catalyst of claim 29 wherein the one or more refractory-oxide precursors comprise at least one precursor selected from the group consisting of aluminum nitrate, aluminum sulfate, sodium aluminate, and aluminum chloride, and wherein the formation of the refractory-oxide material occurs by precipitation of the one or more refractory-oxide precursors.
31. (Previously presented) The Fischer-Tropsch catalyst of claim 29 wherein the one or more refractory-oxide precursors comprise aluminum alkoxides.
32. (Previously presented) The Fischer-Tropsch catalyst of claim 29 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support is a modified transition alumina support.
33. (Canceled)
34. (Previously presented) The Fischer-Tropsch catalyst of claim 29 wherein step (c) further comprises treating the refractory-oxide material to a steam treatment prior to calcination.
35. (Previously presented) The Fischer-Tropsch catalyst of claim 29 wherein the calcination takes place at a temperature between about 700 °C and about 900 °C.
36. (Previously presented) The Fischer-Tropsch catalyst of claim 29 further comprising

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gelling the refractory-oxide material by a sol-gel process before or after the addition of the one or more structural promoter precursors.

37. (Previously presented) The Fischer-Tropsch catalyst of claim 36 wherein the sol-gel process is conducted at a temperature between about 70 °C and about 100 °C.
38. (Previously presented) The Fischer-Tropsch catalyst of claim 36 wherein the one or more refractory-oxide precursors comprise at least one precursor selected from the group consisting of aluminum nitrate, aluminum sulfate, sodium aluminate and aluminum chloride.
39. (Previously presented) The Fischer-Tropsch catalyst of claim 36 wherein the one or more refractory-oxide precursors comprise aluminum alkoxides.
40. (Previously presented) The Fischer-Tropsch catalyst of claim 36 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support is a modified transition alumina support.
41. (Canceled)
42. (Previously presented) The Fischer-Tropsch catalyst of claim 36 wherein formation of the refractory-oxide material occurs by co-precipitation of the one or more refractory-oxide precursors and the one or more structural promoter precursors.
43. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein the calcination takes place at a temperature of between about 700 °C and about 900 °C.
44. (Currently amended) A Fischer-Tropsch catalyst comprising
a hydrothermally-stable structurally-promoted refractory-oxide catalyst support, wherein the refractory oxide is selected from the group consisting of zirconia, magnesia, titania, alumina, silica, and combinations thereof; and
a catalytic metal effective in catalyzing a Fischer-Tropsch reaction, said catalytic metal being dispersed on said catalyst support and said catalytic metal comprising cobalt, nickel, ruthenium, iron or combinations thereof.

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wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support is prepared by a method comprising

(a) forming a refractory-oxide material as a slurry or sol from one or more refractory-oxide precursors;

(b) adding one or more structural promoter precursors to the refractory-oxide material, wherein the one or more structural promoter precursors comprise at least one element selected from the group consisting of W, Ta, Nb, Th, Ge, U, Sn, Sb, V, Hf, Na, K, B, Mg, Si, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sr, Zr, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu; and

(c) calcining the refractory-oxide material at a temperature between about 450 °C and about 900 °C to obtain the hydrothermally-stable structurally-promoted refractory-oxide catalyst support which contains from about 1 percent to about 20 percent by weight of the structural promoter based on the final weight of the catalyst support.

45. (Previously presented) The Fischer-Tropsch catalyst of claim 44 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support undergoes less than a 20 percent change in surface area when subjected to water partial pressures in excess of 5 bars absolute at temperatures greater than 200°C for periods of time in excess of 2 hours.

46. (Canceled)

47. (Original) The Fischer-Tropsch catalyst of claim 44 further comprising one or more catalytic promoters selected from the group consisting of Re, Na, K, Rb, Cs, Mg, Ca, Sr, Ba, Cu, Ag, Au, Sc, Y, La, Ti, Zr, Hf, V, Nb, Ta, Pd, Rh, Os, Ir, Pt, Mn, B, Ru, P, and combinations thereof.

48. (Original) The Fischer-Tropsch catalyst of claim 47 wherein the one or more catalytic promoters are selected from the group consisting of platinum, ruthenium, copper, silver, boron, and phosphorous.

49. (Previously presented) The catalyst of claim 15 wherein the calcination takes place in air at a temperature between about 450 °C and about 850 °C.

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50. (Previously presented) The catalyst of claim 15 wherein the hydrothermally-stable catalyst support undergoes less than a 20 percent change in surface area when subjected to water partial pressures in excess of 5 bars absolute at temperatures greater than 200°C for periods of time in excess of 2 hours.
51. (Currently amended) The catalyst of claim 7 wherein the one or more structural promoter precursors comprise ~~at least one element selected from the group consisting of Co and Zr.~~
52. (Currently amended) The catalyst of claim 15 wherein the one or more structural promoter precursors comprise at least one element in a +4 oxidation state selected from the group consisting of Si, ~~Ti~~ and Zr, or comprise at least one element in a +2 oxidation state selected from the group consisting of Mg, ~~Ce~~, Cu, and Ni.
53. (Previously presented) The catalyst of claim 15 wherein the one or more structural promoter precursors comprise a salt, an oxide, an acid or an hydroxide of said structural promoter, said salt being selected from the group consisting of nitrate, acetate and acetylacetonate.
54. (New) The catalyst of claim 15 wherein the one or more structural promoter precursors comprise at least one element selected from the group consisting of W, Ta, Nb, Th, Ge, U, Sn, Sb, V, Hf, Na, B, Cr, Mn, Fe, Ni, Cu, Zn, Ga, Sr, Ce, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.
55. (New) The Fischer-Tropsch catalyst of claim 44 wherein the one or more structural promoter precursors comprise at least one element selected from the group consisting of W, Ta, Nb, Th, Ge, U, Sn, Sb, V, Hf, Na, B, Cr, Mn, Fe, Ni, Cu, Zn, Ga, Sr, Ce, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.